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ABSTRACT

Intended for administrators or teachers with no prior knowledge of microcomputer applications in education, this document answers frequently asked questions about microcomputers focusing specifically on the use of microcomputers for computer assisted instruction (CAI), drill and practice, and instructional games. Background information covers functions of the microcomputer, educational issues, computer literacy, ways of introducing the topic of computers and applications to educators, a 6-step change process for implementing CAI, and barriers working against instructional uses of computers. Microcomputer hardware is discussed briefly, with emphasis on purchasing considerations, types of systems available, and compatibility. The software section contains a discussion of practical issues relating to software for microcomputers, a format for describing software, descriptions of commercial and public domain programs, instruments to evaluate software effectiveness, a sample program that has been evaluated, and resources for additional information. A list of sample questions which should be addressed by potential users, a glossary, and a 4-item bibliography are provided. (LMM)

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YOUR BASIC GUIDE TO MICRO-COMPUTERS:

A PRIMER...

James L. Olivero
Staff Development, Ltd.
1982

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PROLOGUE

This publication is designed for the administrator or teacher who is a neophyte in terms of micro-computer applications for education. The less one knows about micro-computers the more helpful this Operations Notebook will be.

The author has attenpted to demystify what sometimes appears to be a calculated effort by computer folks to make a reasonab ly simple and straightforward operation unbelievably difficult and complex. This publication is for those individuals who do not belong to the "computer-club" and are willing to admit it.

At least theoretically the author has avoided most of the intricate details and has, instead, answered the most often asked questions about micro-computers and computer-assisted instruction.

J.L. Olivero
Executive Director
Staff Development Ltd.
Author 1982

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Special acknowledgement for assistance on this publication is given to Arthur N. Thayer and Robert Lowe. Arthur Thayer provided the encouragement, enthusiasm and direction to launch this project and Robert Lowe took the time to review the manuscript and to offer constructive criticism especially on those portions of the publication where his computer background and knowledge were timely and concise.

Author

SCENARIO

Setting: Faculty Lounge

Teacher 1: "Well, I see by the bulletin board there is another workshop scheduled on the use of micro-computers. There certainly seems to be a lot of activity regarding micro-computers these days."

Teacher 2: "Yeah, wonder if there really is anything behind all the commotion or whether the subject is another fast-come and fast-go panacea for resolving all the ills of education. Don't know about you, but over my 30 years of life in the education world I've seen so many slick ideas bite the dusty trail I've become somewhat jaded and skeptical when I hear outlandish claims being made."

Teacher 3: "I wonder, too! Not long ago I had the opportunity to visit a school where they had set up a laboratory housing six computers and after all was said and done I wondered whether the students were actually learning anything from their experiences on the machines or whether the principal was on an ego-trip because this was something different being tried at her school."

Teacher 1: "Maybe your experience has been different than mine, but I'm intimidated both by the computers and the people who use them. I still can't seem to operate a 16MM movie projector without having a new set of sprocket holes by the time I'm finished. Can just imagine what would happen if I tried to use some of the complicated stuff."

Teacher 3: "I know what you mean about the computer-club people. They have a language all their own using words like disk-drive, mega-bytes, DOS and other jargon. Makes me feel as if I've stepped onto another planet and the humanoids are using a different language. I get the impression that some people use all those terms just to show how sophisticated they are. I can appreciate what some non-English speaking students must go through when they only understand about every third-word in a sentence."

Principal: "It is quite possible that much of what is happening in the micro-computer field is very faddish. But did you catch the governor's speech on television the other night and the comments he made about high-technology and what schools ought to be doing with boys and girls to help them prepare for the future?"

Teacher 2: "I don't always accept what the governor says as gospel, but I have been interested in the number of times parents have asked about computer applications and what we are doing with our students."

Teacher 1: "I'll confirm that! Apparently quite a few of our students have micro-computers at home and they must be learning something from them. I overheard a conversation between four students on the playground the other day and they were making a date to share computer programs they had developed. Something is happening when kids get together to play on the machines rather than playing baseball or whatever."

Teacher 3: "I agree, there must be something happening. Some of our students spend literally hours playing Pac-man and other games. I wish there were some way I could capture the same kind of motivation and attention for some of the things I'm attempting to teach in class."

Teacher 2: "I'll buy that! Even though I know less than nothing about the computers, I feel a responsibility to learn about their uses especially if they can help get across some of the things I try to teach which seem to go in one ear and out the other."

Teacher 3: "I just wish there were some simple, practical information I could read which would take some of the mystique out of the subject. If I ever do get involved with micro-computers, I'd feel a lot more comfortable with a little background."

Teacher 4: "I've looked over a few articles from time to time in some of the professional journals in our school library, but I often end up more confused then enlightened because the authors of the articles are certainly a few quantuum leaps ahead of my knowledge."

Principal: "You know, I may be able to offer some help. I've picked up a little publication from the administrator's association entitled Your Basic Guide to Micro-Computers...A Primer that has been very helpful to me. It is written at my level of understanding--zero. I'll be happy to share it with you."

Teacher 4: "I am very interested in the subject and would appreciate using it this evening."

Teacher 2: "Me, too!"

Teacher 1: "Me, too!"

Teacher 3: "Me, too!"

The preceding scenario is one that has been repeated in a number of faculty lounges or other places where educators meet to talk about the tools of their trade. Hopefully, this publication will offer some illumination on a subject that is gaining considerable momentum as micro-computers begin to move into the schools. Although the statement is probably impossible to verify, there are some in the know who state that both the hardware of micro-computers and the software double in magnitude every six minutes. Clearly, the potential is great, but there are a lot of unanswered questions. This booklet addresses some of them.

INTRODUCTION

No simple publication is likely to answer all the questions one might raise relative to micro-computers. Definitely, this publication makes no effort to cover all the factors that might be examined. The document is organized into a format which deals with some of the issues under the following headings:

- Background
- Hardware
- Compatibility of hardware
- Software
- Questions to ponder
- Glossary of terms
- Resource listings

There are some publications which focus on such topics as the use of micro-computers for management purposes. Under this headline fall the tasks of attendance recording, student scheduling, grade reporting and so forth. Other publications are designed to evaluate software programs; still others direct the reader to the applications of micro-computers for research and statistical operations.

By design, this publication ignores the preceding topics (and a host of other possibilities) and aims only at the use of the micro-computer for assisted instruction, drill and practice opportunities and instructional games.

The decision was made to attend to these areas for a variety of reasons:

- Teachers and administrators are becoming increasingly alert to instructional applications for micro-computers.
- Currently, relatively little is available in this important area. Although nearly all schools now use computers for one function or another, e.g., budgeting, payroll, inventory control, etc., less than 1% of a typical school district budget is allocated for instructional uses of the micro-computer.

More precisely, this publication looks only at the use of micro-computers as opposed, for example, to a large system of remote terminals tied into a bigger computer.

With the preceding limitations in mind, let's get with it.

BACKGROUND

No Magic

There is nothing really magical about the computer; it works in a much less complicated way than the human brain. Humans have now--and may always have--an advantage over the computer; the brain can think.

For a computer to function, the ideas of humans are put into languages the machinery can understand. Their languages (BASIC, COBOL, FORTRAN, etc.) command the equipment to perform certain functions, and these functions can be performed at incredible speeds.

Some computers are relatively small and others are large. "Small" and "large" is not determined by the actual size of the computer but by the information it can store and/or process. When one hears the terms, "4K, 8K, 16K, etc.," the terms refer to the numbers of characters a computer can hold in its storage system. "K" equals about 1,000 characters (actually K=1,024) so a 4K system is able to store about 4,000 characters while a 16K system can store about 16,000 characters. Generally speaking, the greater the number of characters a system can store the greater the level of sophistication at which a computer can function.

Essentially, there are three major functions performed by all micro-computers:

- Input
- Storage
- Output

Usually, a micro-computer system consists of certain pieces of machinery (hardware) to perform the tasks. For example:

- Input unit -- The most common looks like an electric typewriter, called a keyboard terminal.
- Storage disk -- A space where words and numbers can be stored.
- Output unit -- The most common is a television display screen, but typewriter-like printers are also used.*

Micro-computers may or may not contain one other piece of hardware called a "central processing unit." This unit figures out the meaning of instructions in a program and carries out those instructions. (Additional information about hardware is included in the section which follows.)

No computer will function, however, without software (programs). A computer can solve a problem only if appropriate software is available--and this is the hitch. Up to this point in time, the development of software programs for instruction has been sketchy. In the background research for this publication the author was unable, for example, to find a single program (or set of programs) that would provide an articulated program in any discipline ranging from kindergarten through high school. This is probably the reason that most software programs are written to augment the teacher rather than vice versa.

*A more complete description of system components can be found in a useful publication titled School Administrator's Introduction to Instructional Use of Computers; Moursaud, David. University of Oregon, Eugene, Oregon 97403-$2.50.

As might be expected, however, there is some fear already being expressed that the micro-computer will someday replace the teacher. If ever, that day is far in the future. Perhaps the words of Ken Komoski apply, "If a teacher can be replaced by a machine, the teacher ought to be replaced."

Educational Issues

If the micro-computer software is so limited, why all the brouhaha? There are a myriad number of reasons the micro-computer is looked upon as another tool in the educational arsenal. Fortunately, many of these reasons relate to what is known about effective teaching. Space is too limited here to develop all of the notions, but here are some high-points.

- "Time-on-task" has become a much-used term these days. It appears that many students possess a learning style congruent with the micro-computer format. The micro-computer tends to motivate students to extended periods of "attending" to a prescribed task, especially if the students possess visual and kinesthetic learning modalities.
- The micro-computer--at least with many of the programs--allows students to progress at their own pace. Most programs are written in such a fashion that the student is able to proceed only when she/he gives a command to the equipment that advances the program.
- Micro-computers provide instant feedback and reinforcement. When students know they have been accurate in their actions, they tend to feel more secure taking the next steps. Too, immediate feedback helps to avoid the problem of un-learning and re-learning in those instances when a student has invested time and energy in in-correct initial procedures.
- Micro-computers assist students with "learn-to-learn" skills. Learning is a life-long process and interaction with the computer may help the student realize she/he has the ability to be an independent learner.
- Micro-computers help students develop positive self-esteem. We know enough about educational practices to recognize that success begets success. Good software programs are written at levels consistent with the student's ability. Since the student competes against self and is successful a reasonable percentage of time, the youngster begins to enhance personal self-esteem as she/he realizes there is power in knowledge and she/he has that knowledge.

Although somewhat peripheral to the main points mentioned above, there are at least two side issues worth covering here. Educators realize students can't learn very much in the way of formal education if students aren't in class--or if students in class don't strive for excellence. Studies have already shown some students who have the habit of skipping school are more inclined to attend when they know they can have time at the computer. Moreover, some teachers have found that using the micro-computer as a contingency management tool is quite effective, e.g., "When you get your other work done in a productive manner, you can have a reasonable period of access to work on the micro-computer."

Without going into a lengthy description of the various research studies that support each of the above principles, here are a few contacts readers might consider making if interested in further documentation:

- Dr. Jane Gawronski, San Diego County Office of Education, 6401 Linda Vista Road, San Diego, CA 92111
- Dr. Judy Edwards, Northwest Regional Educational Laboratory, 300 S.W. Sixth Avenue, Portland, Oregon 97204
- Dr. Shirley Easterwood, Association for Educational Data Systems, 1201 16th Street, N.W., Washington, D.C. 20036

or refer to an excellent article in Educational Leadership, "How Effective is CAI; A Review of Research," 1975, 33 pages 147-153 (Edwards, J., Norton, S., et al).

Directions

Even though we know so little about what may prove to be so much, a number of state and/or national groups have gone on record to define a model set of goals for the integration of the computer into the instructional program. One of these groups is the highly respected Conference Board of Mathematical Sciences, a national organization of math-oriented professional societies is the United States. The following is a reasonable restatement of their position:

- All students should become computer literate. They should learn about how computers work and how computer applications can help to solve a variety of problems.
- The use of computers should be integrated into all levels and areas of the curriculum.
- Computers should gradually grow in importance and use--with caution to make applications only when they are economically viable and educationally valuable.

AUTHOR'S NOTE:

Even though practically no emphasis in this document is given to the subject of computer literacy there is growing support for a course offering this subject.

In short, there are, indeed, enough claims being made about the appropriateness of micro-computers for instructional applications to look beyond the smoke to see what can be found.

In The Beginning

But where to begin? There is no one strategy that fits every situation; the nearly universal comment made by those who have begun using micro-computers is, "If we had to do it over we would take a different approach." There is a consensus of opinion, however, that in-service education for both administrators and teachers is crucial. "In-service" is a broad statement and one can conceive of any number of activities that might be undertaken. The tendency to study an issue to death is a certain way to eliminate the drive and commitment to an educational improvement effort.

One large school district quickly comes to mind when the study-to-death obstacle is mentioned. This particular district has been studying the use of micro-computers for five years. The teacher who first suggested using computers has become disillusioned with the educational leaders in the region. Teachers grow frustrated when they believe the administration finds ways to keep things from improving rather than facilitating the process!

A couple of the teachers, however, found ways to circumvent the perceived foot-dragging. These teachers either purchased micro-computers on their own, talked sales-representatives from micro-computer companies into loan-demonstration arrangements, or found ways to bring student-owned equipment into the classroom. Teachers usually can find some way to get around the system. It is unfortunate, though, when beating the system becomes the modus operandi.

As one considers in-service possibilities there is a good chance one will run smack into a typical paradoxical problem that goes like this:

Educator A: "Before we begin planning an in-service program we need to define precisely what we want the students to learn as a result of experiences with the micro-computer. In other words, we need to know the purposes we believe the micro-computer can support."

Educator B: "From my point of view, we can't decide the purposes until we know what the micro-computer can do."

Clearly, there is truth in both statements and the temptation to wave away these fundamental issues with the glib pronouncement, "The micro-computers can do anything you tell them to do," isn't very helpful. This panacea-like statement is, at best, light-years away from reality. Raising false hopes and expectations leads to later frustrations.

The fact of the matter is, educators most likely need a magic blend of experiences where they learn both about what computers can do and, at the same time, consider purposes for which the computer can make educationally sound contributions.

As people are different, there are--obviously--different ways to introduce the subject. Some prefer minimum guidance as they make initial explorations. Others feel most comfortable in a formal learning environment, an environment where beginners engage in similar activities. Major benefit comes from actual involvement in hands-on experiences. Educators can quickly assess, on their own, the potential--or lack of potential--for micro-computers.

Unless one has strong motivation, it is probably unwise to begin a neophyte by introducing skills to write programs, i.e., to teach one or more of the computer languages. To many educators, micro-computers will be similar in many ways to the automobile they drive. Those in this category might make the following statement about their car, "I know how to turn on the ignition and to use the foot pedals, but I couldn't care less about pistons, transmissions, and the ingredients of the gas." About computers they might say, "Just tell me how to make the computer go."

There will, undoubtedly, be educators who become so knowledgable they will be able to disassemble and put a micro-computer back together blind-folded. These "super-techs" will, however, be far outnumbered by those who wish only to know minimum information. "Tell me where to load this thing, what buttons to punch, and who to call when it isn't working."

As mentioned above, hands-on experience is crucial. Two recent examples of problems help to illuminate this point. There is one school district that, because of efforts by the superintendent, received a gift of twenty-four micro-computers. The computers were brand-spanking-new--at least as far as educational applications were concerned. At the time of this writing, though, district representatives are busily scrambling around to locate educational software. To suggest the administrators look somewhat foolish to teachers is a gross under-statement. Unless the district comes up with something fast, it may have been more cost-effective to purchase micro-computers for which software was already available. If the district is forced to invest time and money (and people) in software development, something that probably looked at first glance like a terrific idea may turn sour. In this situation, greater attention should have been given to the "purpose" issue. If people in the district had engaged in hands-on exercises, it would not have taken long to discover the software limits.

Another high school, located in a large district in Gerogia, houses 32 micro-computers--16 TRS-80's and 16 Apple II's. An observer at the school is quickly exasperated when it becomes clear students are heavily into black-jack as opposed to educational programs.

It took considerable investigation to figure out what went wrong. Simplified, a bright and forceful teacher convinced a proposal writer that "disadvantaged" students would improve their achievement scores if micro-computers were available. Soon the proposal was funded and the micro-computers arrived at the school. By then, however, the teacher had been transferred to a new position in the district--and no one else at the school knew what to do with the equipment. Somehow, one of the students followed the directions for activating the black-jack program and the micro-computers have been humming ever since. This is a sad but true story. Woe is us!

Undoubtedly, the school would have had more going for it if a greater number of teachers had been involved. As it was, some of the teachers were frightened by the systems and the administrators apparently had neither the time nor the inclination to correct the situation. Once equipment is purchased, it is a little late to begin figuring out what to do with it.

Change Process

For those who wish to begin someplace, perhaps this systematic process will be useful. The process involves six steps:

- Awareness
- Information
- Assessment
- Modification
- Pilot
- Institutionalization

Awareness of micro-computers is a good place to start. Hands-on experiences are preferable but reading or hearing experts talk about micro-computers is also helpful.

Gaining detailed information about micro-computers is the next step. There definitely should be hands-on activity during this phase. This is a good time, also, to visit a few schools where students use educational software. Care should be taken in this phase to find a responsible person (sometimes an educational consultant, but less frequently a micro-computer salesperson) who is cognizant of computer functions and educational demands. (Some people know one thing or other but we are too early in history to have many people who are expertly knowledgable about both.)

Third phase is assessment. This is a time when individual teachers as well as task forces of educators work on the "purposes" matter. During this phase, the "what" issues are addressed, i.e., for what purposes are we planning to use micro-computers?

The fourth phase is described as the modification phase. By this time teachers and administrators should have checked a couple of school sites, looked over alternative micro-computer systems and played with some software. Human nature seldom fails; when people look at something operational they instantly conceive of ways to make it better--at least in their own school or classroom. If educators observe a micro-computer laboratory they may want to modify this arrangement by deciding to put a single micro-computer in each classroom. Or, if educators observe a TRS-80 system, they might make a decision to install the Commodore/PET. Sometimes modifications improve the potential for outcomes because people tend to "own" what they create. There are some things in any system that cannot be modified. In this phase discover the difference between those that can and those things that cannot be changed.

Look before leaping! No sage is necessary to make this comment. Before fully launching into myriad micro-computer applications take time to pilot any system. Because of fiscal limitations for schools, there isn't much likelihood a micro-computer for each student will be purchased. But even if this were possible, begin small. Look for answers to predefined questions as the system is tested.

Here is a sample question illustrating an issue that might be addressed during the pilot stage:

> One school district in Arizona has shown remarkable leadership in micro-computer applications for educational uses. The assistant superintendent began working with groups of teachers nearly six

> years ago to pilot-test ideas. Even after this length of time, they insist they are still at the pilot stage. One question they are wrestling with now is a rather old story wrapped in a new binder; there are debates between teachers regarding the particular level at which a given software program may be used. The debate is similar to the discussion many educators have heard at one time or another. "You can't use that film in your third grade class because I'm planning on using it with my fourth grade class."

Most districts have not advanced micro-computer pilot-testing very far, but anticipating and solving problems is critical at the pilot stage. Too many promising educational practices have been lost because pilot-testing was ignored--resulting, frequently, in the baby being thrown out with the bath water. (Later in this publication are sample questions people in school districts might find helpful to ponder during the piloting phase.)

The last stage mentioned in our process is instructionalization. This jargon-type word means pilot-testing has been completed and micro-computer applications are integrated into regular operations. Most problems in the system have been resolved. Not many school systems have completed the six steps outlined above. Although districts have progressed to the pilot-testing phase, the majority are still at phases two and three.

Barriers

Those who consider major barriers working against instructional uses of computers find a diverse set of obstacles. Here are some top hurdles to jump:

- Availability of hardware
- Availability of software
- Teacher support
- Administrative and school board support
- Parental support
- Knowledgeable teachers

By far the greatest problem today is a lack of teacher and administrator knowledge about the use of computers in education. This problem overshadows the total of the other areas above. As a result, in-service is a plausible action. (Some barriers are more perceived than real, e.g., more hardware and software are available than generally perceived. In-service can help to reduce or eliminate incorrect information.)

Before closing this background section, a few additional factors are worth considering--money is one of them. This issue can't be taken lightly considering the economic climate of schools. Perhaps there will soon be a dramatic turn-around, but chances seem slim. Those considering micro-computers should know implementation plans will cost more money! Irrespective of claims made for increased student achievement and improved classroom management, and aside from all the other wonderful outcomes, the "if/then" question regarding dollars is paramount, i.e., If we are going to include micro-computers in our instructional program, then how much will it cost? There is naturally, no one answer. Best advice suggests consideration of both immediate and long-range factors. (See Hardware and Questions Sections of this publication.)

Not long ago, Ed Obie (Alaska Department of Education--very knowledgable authority on educational technology of all varieties) prepared a valuable document titled "Planning for Computers in the Classroom." His paper calls attention to many of the points made above. (His points here may also be instructive to beginners.

- Plan instructional applications rather than technological applications.
- Buy now--wait later. Except in rare circumstances, don't hesitate to buy state of the art equipment now because you think something newer and better is coming tomorrow. The same decision will face you if you decide to wait.
- Change is a central concept in implementing computer applications successfully. "Implementing change" might be more appropriate terminology than "implementing computer applications." Human nature often implies a resistance to change unless the amount of gain is equal to or greater than the amount of effort requried. Chances for success are enhanced if there is user involvement, adequate in-service and appropriate follow-up.
- Plan a broad-based approach to computer implementation. For long-term success, it is crucial to integrate a computer application into the curriculum in a formal sense to prevent "person dependency."

We could go on-and-on with background information, but we'll close here and move on to a short discussion regarding micro-computer hardware.

MICRO-COMPUTER HARDWARE

This section won't be very long; there is no reason to describe all the hardware available for micro-computers because the size of this publication precludes any such effort. By the time this publication reaches readers, much of the hardware description will be obsolete--the status of micro-computers changes rapidly.

Because the section is abbreviated, however, is no reason to overlook the significance of hardware. As micro-computers are relatively new in educational settings the old adage of, "Let the buyer beware," is an adage to heed.

One isn't around educators who have had experiences with micro-computers very long until horror stories begin to emerge. (On some occasions it seems each person trys to out-frighten the next person.) Stories of woe range from those who first thought they made a super-killing by buying in quantity from a out-rate micro-computer outfit to people who become increasingly furious when they learn add-ons cost as much or more than the core equipment.

Sound advice comes from a district business manager who works in a large, suburban district outside St. Paul, Minnesota. She urges educators not to purchase anything--either hardware and its accessories, or software--until one has had an opportunity for hands-on experiences with the total system. "If you don't see it work, don't buy it," is her advice. May sound somewhat cynical, but better careful than sorry.

Caution is underscored here because the individual first learning about micro-computers often asks a question similar to, "Will the system...?" An honest answer, from those who wish to provide honest answers, will be, "Yes!" A beginner, however, may not listen carefully enough to all the "ifs," "ands," and "buts" on which the answer was contingent. Save time and trouble, toy with it before buying it.

Here's an example of the toy-buy advice. Recently a teacher purchased (through the school district) a micro-computer with an add-on printer. The purchase price was reasonably high so the principal and the business manager questioned both the teacher and the micro-computer salesperson to make certain the purchase order covered everything necessary to make the system operational. The people questioned responded in the affirmative. The purchase was made. Unfortunately, once the hardware arrived, there seemed to be some sort of problem. The printer didn't print. A telephone trouble-shooting call to the salesperson revealed one small problem. A key had been omitted from the purchase order. Nearly anyone can guess the rest of the story:

Micro-computer rep: "Well, no, we don't have the key in stock, but we will be glad to order it for you."

(Three weeks later)

Micro-computer rep: "The key arrived today and you can pick it up when you wish. Oh, yes, please bring an additional $112.57 to cover the cost."

Naturally, this isn't the end of the story but the scenario is so familiar there is no need to continue with it. Suffice it here to say there is currently one nearly complete micro-computer system; one embarrassed and upset teacher; and two furious administrators. If anyone had taken the time to see the system work, the entire negative situation might have been avoided.

One prime consideration for the purchase of equipment is the availability of software. Testing software offers another opportunity for hands-on experience.

Fortunately more and more intermediate educational agencies, e.g., county offices of education, education service districts, regional educational laboratories, boards of cooperative educational services, etc., are beginning to organize facilities where educators can preview both hardware and software. The San Mateo County Office of Education in Redwood City, California, is one exemplary site. Arranged in a comfortable location within the larger county office facility are a number of different micro-computer systems; each system is operational and, with a minimum of direction from the county staff, a potential user can engage in first-hand contact.

If an individual school district tried to replicate the San Mateo County model, an excessive amount of money would be required--money reflected in dollars, personnel, space, and so forth. A central location where teachers and administrators can converge is very sensible.

One imaginative leader who heads an intermediate agency in Texas believes he has found a way to avoid the purchase of hardware while still offering hands-on experiences for potential users. In this center, emphasis is put on software, especially software written by non-commercial developers. A

library of public domain (non-commercial) software for use on different types of systems has been gathered. Additionally, arrangements have been made with local, micro-computer, hardware companies to allow testing of software programs. A potential user simply checks-out software from the library and proceeds to one of the local merchants. This approach--allowing for some inconvenience--has several advantages. The center avoids an expenditure for hardware; the center performs a valuable service for potential users; the user is able to test top-of-the-line and state of the art hardware; and the micro-computer representative has a potential sale walk in the front door. Schools and other commercial agencies may be able to help boys and girls and still help one another.

If one visited a facility to preview hardware, what might be seen? Although new micro-computers are being developed all the time, one might begin by looking closely at one or more of the top four, e.g., Atari, TRS-80, PET, or Apple. Each of these micro-computer companies has engineered hardware to perform a variety of applications. Moreover, each company is constantly in the process of upgrading equipment--making it faster, making it store greater data, making it perform more sophisticated functions. Radio Shack, for example, pioneered the TRS-80. A quick look at the TRS-80, though, shows it isn't one computer, but--at the present time--six computers. The TRS-80 pocket computer is about the size of a hand-held calculator while another TRS-80 system might include a 64K Model II, 3-drive external disk system, Line Printer V and Printer Cable. Obviously, the latter system performs some operations the first system doesn't. No matter which system studied, potential users must ask the question, "What hardware do we need to do the job we want done?"

Beginners often find it worthwhile to purchase a "starter" set of equipment and to build on as knowledge about the system and as improved software becomes available. A beginning system might include a small micro-computer, a line printer and, perhaps, a disk drive or two. As a system is enhanced, the user may decide to trade in used equipment usually made up of separate components for a new system where most (if not all) of the extras are built in. As it is impossible to describe all the equipment and accessories--a visit to a sales location is a must. Prior to that visit, however, the beginner may want to scan a product catalog. In the catalog one may notice equipment as basic as "joysticks" along with equipment as slick as telephone modems. Or even hardware that allows instant access to national information networks like Dow-Jones.

The system with the most pizazz, perhaps, is the computer interactive video system. When complete, the system consists of a random-access video-tape recorder, a micro-computer with disk drive, a display screen and a word printer all interfaced (tied together). The system displays a picture from the video-tape on the television monitor, automatically starting and stopping the tape at prearranged times. The micro-computer is programmed to display questions and/or comments on the screen, reinforcing or assessing what the viewer saw earlier. If the person interacting with the system answers the questions correctly, the video-tape advances to new information. When answers are incorrect, the video-tape automatically rewinds to the portion where the "missed" information is replayed. (Theoretically an entire course could be developed using the preceding format.) This approach could also be supplemented by text, film and other materials and personnel in a school.) A printer records student data, i.e., the number of correct and incorrect responses, the

time it takes a user to complete a specific instructional episode, and so forth. The system has two other unusual and dramatic capabilities. By using a precise formula, the computer can produce questions written at a level congruent with any learner's reading ability. Using another formula, the computer can produce questions at any level of difficulty, using Bloom's taxonomy as the hierarchy model. The potential for the computer interactive video system appears unlimited. By premeditated design more is not written here about hardware; hopefully the descriptions are titillating enough to the user that she/he will invest four stamps and write a brief note to request a free catalog from these (or other) sources:

Radio Shack
1600 Tandy Center
Fort Worth, Texas 76102
(TRS-80)

Learning Consultants
920 Kline, Suite 100
La Jolla, California 92037
(Commodore/PET)

Mosaic Electronics
P.O. Box 748
Oregon City, Oregon 97045
(Atari)

Random House School Division
400 Halen Road
Westminister, Maryland 21157
(Apple)

The Educational Products Informations Exchange (EPIE) Institute also gathers and disseminates information about instructional materials, equipment, and systems. A recent edition of the EPIE Equipment Report, a quarterly publication, is titled, "Microcomputer Hardware/Interactive Video Systems". This publication provides guidelines for buying micro-computer hardware, comparative descriptions of 12 micro-computers used in education, and a discussion of "interactive video systems" that combine computers and video technology for instruction. The publication can be obtained from EPIE Institute, Box 620, Stony Brook, New York 11790 for $25.00.

> NOTE: The citing of these sources is given as a service to potential users; there is no intention to endorse either the organizations or the products. If one lives in an urban area, s/he should probably disregard the sources and do as they say in the commercial--"Let your fingers do the walking through the yellow pages..." The yellow directory for San Jose (may be a biased directory in favor of computers) contains seven full pages, covering some 125 representatives). When using the yellow pages, look under the heading of "computers."

At least two other matters regarding hardware need attention. One matter has to do with maintenance and the other is the oft discussed issue of "compatibility."

Because micro-computer hardware is equipment (machinery), there are times when the system needs maintenance. Maintenance varies from plugging-the equipment-in-problems to loose-chip-problems. As with most situations, prevention is better than remediation. Pre-purchase considerations might well focus on quality support service. Purchasers should realize there is substantial difference between a salesperson and a service person. A salesperson doesn't mean there are enough service personnel to accomodate, effi-

iently, a large volume of requests for service. Buyers need to know how many service agents are available, how fast they make repairs, and how effective are the repairs. By obtaining a list of other users in the area and then contacting them by telephone, potential buyers can grasp a good knowledge of maintenance possibilities.

Compatibility

Various school districts contemplating the use of micro-computers have invested countless hours of inquiry attempting to determine which system to purchase. The "compatibility" topic in these districts gains more than sufficient discussion. Compatibility, in fact, may be a straw-man issue, an issue blown all out of proportion to its importance. The notion which follows may appear somewhat unorthodox, but please bear with the thought for a few sentences and then make a judgment. Consider micro-computer systems, for example, as one might consider a commuter airline. Most commuter airlines own a variety of airplanes. Each plane is available depending on the demands for passenger service. If only a few passengers travel, a small plane is put into service; more passengers require a plane with greater seating capacity. There is consistency between requirements and equipment. The same with micro-computers. Because micro-computers use different machine languages and because most software programs are not interchangeable, it makes sense to purchase equipment consistent with user requirements. This means a given school could own three or four different kinds of micro-computers, each performing unique functions. When equipment performs the same function, it is logical to obtain compatible hardware. Take care, however, not to make too much out of the compatibility issue.

One final note. The following comment won't win many friends among the hardware sales corps, but the thought is worth considering. Unfortunately, there appears to be a tendency among computer reps to sell more hardware than is necessary. "Overkill" is not cost-effective. Idle hardware may cause outside observers some skepticism about educator responsibility and knowledge. The automobile salesperson is often characterized as a person who offers a satisfactory price for a basic automobile, but then drives the buyer bananas with all the add-ons--jacking up the final price. Each piece of hardware is designed for a discrete function; interact with the equipment and the software before putting dollars on the line.

SOFTWARE

Although there is some minimal debate, software is at the heart of any micro-computer application for instructional purposes. There is no doubt that the state of the hardware out-reaches, in both quantity and quality, effective software. Recent developments, however, are helping to bridge the chasm between software quality and hardware achievements.

In this section of the primer, the following information is included:

- Practical issues relating to software for micro-computers.
- A format for describing micro-computer software.
- Descriptions of software programs, both commercial and public domain (non-commercial).
- Instruments to evaluate the effectiveness of software.
- A sample program that has been evaluated.
- Resources for additional software information.

Practical issues relating to software can, somewhat arbitrarily, evolve around three topics. Each topic demands caution.

- Before purchasing any software, make certain the computer system will handle the program requirements, i.e., the micro-computer has adequate storage to do the job and the software language is compatible with the micro-computer system.
- Be wary of exaggerated course-ware claims. Clearly, the development of software for educational purposes is only now at the baby stage. Care should be given to the program's technical and instructional aspects as well as to the content. One should be prepared to find errors in content and format, including programs produced commercially as well as by other "non-expert" developers.
- Give considerable attention to the idea of purchasing existing products rather than developing in-house programs. Many fine in-house programs have been developed, but authorities generally agree a minimum of two years of dedicated training is necessary to master a programming language. There are some estimates that it takes between 20 and 200 hours of programmer time to produce one hour of classroom instruction. Few educators have the time to meet the requirements. Search what has been programmed before "re-inventing the wheel."

Software quality ranges from poor to excellent; as one reviews programs it seems students could profit as much from good ditto-sheets as from the relatively poor software. The statement is debatable, but some people claim the poorest computer games are better than the best instructional programs. True or not, the statement serves as a point of reference. From a slow beginning, though, one can envision the day when software programs will compete with textbooks for inclusion on state-approved lists. That day may not be far off.

Not only is it difficult to locate quality programs, it is a time-consuming chore to locate software, period. Here is one format that can be used to describe programs.

Title of Program: _____

Subject Area (e.g., English, mathematics, science, etc.): _____

Grade Level: _____

System Required: _____

Program Description: _____

Approximate Cost: _____

As software searches are conducted one soon discovers many are written by people who work for companies that produce the hardware. Additionally, there are companies that produce software even though they do not invest capitol in hardware development. Fortunately, there is now an increase in programmers who are qualified in both computer language and instructional content. As well as commercial experts, educators also write some programs. Many educator-produced programs are "public domain," i.e., the programs can be copied without causing copyright infringements. Summarized below are a few commercial and public domain descriptions.

TITLE: Video Easel

SUBJECT: Art GRADE LEVEL: K-9

SYSTEM: Atari 400/800 (Cassette) (Joystick Controllers)

DESCRIPTION: This program is a unique combination of video art, both computer-generated and user-generated, together with a computerized version of the game of "life."

The program uses a "main menu" and a "life menu" accessed by keyboard. Detailed user instructions are supplied. The "video art" portion contains a wide variety of options. In the "drawing" mode, one or more joysticks can be used to draw patterns on the screen. "Painting" contains six preprogrammed repeating designs.

APPROXIMATE COST: $39.95

TITLE: Mastertype

SUBJECT: comprehensive - any subject GRADE LEVEL: 6-12
SYSTEM: Apple II Applesoft 48K (Disk)

DESCRIPTION: This program consists of 17 lessons in arcade game format that present typing skills and give practice with them at levels from beginner (where to place fingers) to advanced.

APPROXIMATE COST: $39.95

TITLE: Scripsit

SUBJECT: comprehensive - any subject GRADE LEVEL: 7-12
SYSTEM: TRS-80 Model I/III (Cassette) (Printer Required)

DESCRIPTION: Scripsit allows a student or teacher to compose and edit text passages on the video display and then to print the copy on a printer in any format desired. Text may be saved for later use on a tape or cassette or, if available, on a diskette.

APPROXIMATE COST: $39.95

TITLE: Word Race

SUBJECT: comprehensive - any subject GRADE LEVEL: 10-12
SYSTEM: TRS-80 Model I/III 16K (Cassette)

DESCRIPTION: The program displays a race track on which each of two players has a car. The program displays a word and the first player to identify the correct meaning gets to move his/her car one square forward. Wrong guesses retards the player's car one square. The words included with the program are high school level, but may be changed easily.

APPROXIMATE COST: $7.95

TITLE: Word Families

SUBJECT: Language Arts GRADE LEVEL: 1-4
SYSTEM: Apple II Applesoft 48K (Disk)

DESCRIPTION: Word Families gives practice in substituting a letter in a word to spell another word. The teacher may select substitution of the beginning or final consonant or medial vowel. The screen does not change for incorrect responses, but such responses are recorded in the student's disk file. A graphic reinforcer is provided each time the student answers five presentations correctly.

APPROXIMATE COST: $29.95

TITLE: MECC Elementary Volume 2

SUBJECT: Language Arts-Curriculum Area GRADE LEVEL: 1-6
SYSTEM: Apple II 3.2 DOS 48K (printer required)

DESCRIPTION: Six programs on one diskette provide ready-made spelling lists, crossword puzzles or other word study activities. Teacher may create mazes, crossword puzzles, mixed word lists or weekly spelling lists with simple instructions built into the programs.

Good documentation comes with the program.

APPROXIMATE COST: $29.95

TITLE: Let's Spell

SUBJECT: Language Arts GRADE LEVEL: 2-3
SYSTEM: Atari 400/800 8K (Cassette)

DESCRIPTION: Let's Spell is a series of 4 spelling programs designed for the early elementary level. The first 3 programs present 30 words each, and the last is a test of all 90 words.

The words are presented in groups of 5, using a voice track. The child is shown a word and asked to type it. Then a sentence using the word is given and the student is asked to type in the word (without seeing it on the screen). If a mistake is made, the computer immediately tells the child, and he/she is asked to try again. After completing the first 5 words, a review test is given, and after the child completes the 30-word lessons, another test is given.

APPROXIMATE COST: $14.95

TITLE: Subjects

SUBJECT: Language Arts GRADE LEVEL: 4-8
SYSTEM: Commodore PET Disk)

DESCRIPTION: This program asks the student to review a set of seven statements and to pick out the subject in the sentence. The student's score is recorded at the end of the program. The use of questions and statements give the user an opportunity to see the subject used in a variety of positions.

APPROXIMATE COST: Public Domain

TITLE: Compu Spell

SUBJECT: Language Arts GRADE LEVEL: 4-9
SYSTEM: Apple Applesoft 48K (Disk)

DESCRIPTION: Spelling is practiced while being monitored. The computer presents words in sentence context. The word is then blanked, and the student types it in. The program doesn't respond when incorrect answers are used. The program records performance for up to 60 students in individual disk files and produces reports. Six word disks are provided with 800-1,700 words each.

APPROXIMATE COST: program and one word disk $39.95
additional word disks $19.95 each

TITLE: Smarty the Computer

SUBJECT: Language Arts GRADE LEVEL: 4-11
SYSTEM: TRS-80 (Disk)

DESCRIPTION: There are three small programs included: Memory Game, Spelling Bee, and Etch-a-Sketch. These games vary in difficulty and the student has a choice of the difficulty. Memory Game is a powerful program which demands strong attention; speed at typing is also beneficial when the user competes against the computer.

APPROXIMATE COST: Public Domain

TITLE: Tennis Anyone?

SUBJECT: Language Arts GRADE LEVEL: 5-9
SYSTEM: Apple II or TRS-80 DOS 3.3

DESCRIPTION: While the computer simulates a tennis game the student is asked to select the correct affix from a list given on the screen. A tennis scoring format is used to show the results. There are 6 programs in the total package. The program consists of 18 games--3 rounds of 6 games each, any round of which may be preselected by the students.

APPROXIMATE COST: Individual packages $29.95
Total package $170.75

TITLE: Computer Poetry

SUBJECT: Language Arts GRADE LEVEL: 7-12
SYSTEM: Commodore/PET (Disk)

DESCRIPTION: The program is written for users who have interests in poetry ranging from great to little, or even unknown. Information about poetry is offered and opportunities to write poetry are made available.

APPROXIMATE COST: Public Domain

TITLE: Crossword Magic

SUBJECT: Language Arts GRADE LEVEL: 7-12
SYSTEM: Apple Silentype (Requires a printer) 48K

DESCRIPTION: Provides drill on word recognition, vocabulary, spelling, and typing skills. User can supply words from any subject. Crossword Magic automatically interconnects them to form a puzzle.

APPROXIMATE COST: Diskette package with booklet $79.95

TITLE: Word Search: Spanish

SUBJECT: Foreign Language GRADE LEVEL: Bgnr-Advncd
SYSTEM: Atari 400/800 16K (Cassette) (Joystick Controlled)

DESCRIPTION: Word Search: Spanish is a 3-program educational package. The first two programs are joystick controlled and the last is a printer version that allows the user a hard copy puzzle.

Ten common Spanish words are hidden among a 10X17 letter grid. The words can be concealed vertically, horizontally, diagonally, forward and backward. As the user finds the words, the English translation is shown. Once all the Spanish words in the first program are found, there are plenty more on the second program (over 300 words between the two).

APPROXIMATE COST: $14.95 (Similar programs for the same price are also available for French and German)

TITLE: Spanish, French, Italian, German Vocabulary Drills

SUBJECT: Foreign Language GRADE LEVEL: 7-12
SYSTEM: Apple II Plus 48K (Disk)

DESCRIPTION: Provides practice in foreign vocabulary by means of 3 types of drills: Matching, foreign-English, and English-foreign. The diskette comes with sample lessons on it; however, the user may enter vocabulary from any source.

APPROXIMATE COST: $24.95

TITLE: French Hang-man

SUBJECT: Foreign Language GRADE LEVEL: 8-10
SYSTEM: Apple II 48K DOS 3.2 or 3.3 (Disk)

DESCRIPTION: French Hangman gives practice in translating words and sentences, in both directions, between French and English. Program includes 50 words on each of six difficulty levels and 25 sentences on each of seven levels. Students are allowed four wrong responses before the correct answer is given. After work is completed on a word or sentence, a cummulative percentage-correct report is given.

APPROXIMATE COST: $29.95

TITLE: Count to 30 & Count to ?

SUBJECT: Mathematics (Counting) GRADE LEVEL: K-1
SYSTEM: Apple II 32K DOS 3.3

DESCRIPTION: This is a counting program for primary only. Symbols appear on the screen in rows of 10. Student may count as the symbols appear. This program could be used for a whole class simultaneously. Teacher may also teach the name of the symbols; $, *, &, etc.

APPROXIMATE COST: Pulbic Domain

TITLE: Hurkle

SUBJECT: Mathematics (Geometry) GRADE LEVEL: K-3
SYSTEM: Commodore/PET 8K (Cassette)

DESCRIPTION: The goals of this game are to provide practice in the use of a coordinate system, to develop logical thought processes, and to reinforce the concepts of left, right, up and down. The student tries to find the missing Hurkle which is hidden on A 10X10 grid. The student enters his/her guess as a pair of coordinates. The named grid point is lightened, and both visual and auditory clues are given to indicate the direction of the Hurkle's hiding place. When the Hurkle is found, a flashing picture of Hurkle is shown.

APPROXIMATE COST: $5.00

TITLE: The Math Machine

SUBJECT: Mathematics GRADE LEVEL: K-12
SYSTEM: Apple II Applesoft 48K (Disk)

DESCRIPTION: This program allows the user to practice arithmetic with a game reinforcer. It gives practice in working elementary math problems ranging from pre-math skills to division. Teachers can assign an appropriate skill level and reinforcement schedule for the student. The student works through the math problems and is then reinforced with a game of his/her choice. If the student gives two consecutive incorrect responses on any problem, the program will respond with the correct answer.
Graphics and sound are used extensively throughout the program.

APPROXIMATE COST: $79.95

TITLE: Anroid Nim

SUBJECT: Mathematics (Game) GRADE LEVEL: 1-3
SYSTEM: Commodore / PET (Disk)

DESCRIPTION: This program is set up in such a way that the computer competes against the user. The student tries to mainipulate the responses so he/she is able to eliminate the last Nim on a series of three columns.

APPROXIMATE COST: Public Domain

TITLE: Boxes

SUBJECT: Mathematics (Add & Subt/Intro to Algebra) GRADE LEVEL: 1-3
SYSTEM: Apple II 32K DOS 3.3

DESCRIPTION: Students are introduced to algebraic equations using simple single digit addition and substraction problems. Student selects which numbers in the equation will be the unknown. Student selects addition or subtraction. Concept of "1 more" is also demonstrated as the student accumulates "right" answers.
Color graphics, immediate feedback.

APPROXIMATE COST: Public Domain

TITLE: Hickory-Dickory Clock

SUBJECT: Mathematics GRADE LEVEL: 1-3
SYSTEM: Atari 400 (Cassette)

DESCRIPTION: This program places the face of a clock on a display screen and the hands are placed at various locations. The student has the options to pick from: Hours, half-hours and minutes. Student can indicate the number of tries he/she would like to take on each of the options.

APPROXIMATE COST: $14.95

TITLE: Compu-Math Arithmetic Skills

SUBJECT: Mathematics GRADE LEVEL: 1-4
SYSTEM: Apple 48K (Disk)

DESCRIPTION: This is a tutorial on 4 basic operations. Step-by-step instructions are given for addition, subtraction, multiplication and division. The student is moved to the next level based on his/her performance. It includes provisions for individually prescribing instructions.

APPROXIMATE COST: $49.95

TITLE: Hurkle

SUBJECT: Mathematics -Intro. to Coordinators GRADE LEVEL: 1-4
SYSTEM: Apple II 32K DOS 3.3

DESCRIPTION: This is a game using x,y coordinates in a 10X10 grid. A Hurkle is hidden in one of the grids. Color and written clues are given to assist the student in making logical guesses. Student is also introduced to 8 points of the compass. Maximum of 5 guesses allowed. Replays indefinitely

APPROXIMATE COST: Public Domain

TITLE: Multiplication

SUBJECT: Mathematics GRADE LEVEL: 1-4
SYSTEM: TRS-80 Model I/III 16K (Cassette)

DESCRIPTION: The program gives on-screen practice in multiplying whole numbers in the same manner as one would do on paper. User may choose any of 5 difficulty levels. During problem, a blinking cursor indicates the position of the digit to be entered. The student may either enter a digit or ask for help in finishing the problem. An end-of-session report gives the number of problems worked correctly with/without help.

APPROXIMATE COST: $74.95

TITLE: Apple Barrel

SUBJECT: Math, Counting/Estimating GRADE LEVEL: 1-5
SYSTEM: Apple II Plus 32K 3.3 DOS (Disk)

DESCRIPTION: Color graphics are used to establish a simulation in which "Farmer John" collects his apples in a barrel but needs someone to tell him "how many." User may use any math function to derive the answer.

Could be used for small group drill. The size of the barrel is selected by the user. This determines the level of difficulty for each problem.

APPROXIMATE COST: Public Domain

TITLE: Clock

SUBJECT: Mathematics GRADE LEVEL: 1-5
SYSTEM: Apple II (Applesoft) 48K 3.3 DOS (Disk)

DESCRIPTION: This program provides practice with clocks in three modes: setting the hands of a clock from digital time; reading a clock and typing the digital time; setting clock hands from time given in words.

Each mode can be given in any of five difficulty levels which are based on the precision with which an answer must be given; this ranges from level 1 (time correct to one hour) to level 5 (time correct to one minute).

APPROXIMATE COST: $49.95

TITLE: Math Pak I

SUBJECT: Mathematics GRADE LEVEL: 1-5
SYSTEM: TRS-80 Model I 16K (Casette)

DESCRIPTION: The package contains one program for each of four basic arithmetic operations on whole numbers. All operate more or less like addition which is as follows. First, questions to specify problem difficulty are answered. Then, 10 problems are displayed. The program accepts a result, digit by digit at the bottom of the screen. If a digit is correct, it is filled in under the problem. If a digit is incorrect the problem so states and gives another chance--up to five trials per digit. If student's score is 90 or better, s/he is rewarded with a game of "Bomber."

APPROXIMATE COST: $14.95

TITLE: Addition With Carry

SUBJECT: Math GRADE LEVEL: 2-8
SYSTEM: Atari 400/800 8K (Cassette) (Joystick Controlled)

DESCRIPTION: Additon With Carry is an arithmetic drill program. The program is joystick controlled. The software is designed for younger students already familiar with the "carry" concept. Problems range from two single-digit numbers to seven five-digit numbers. The computer prompts the student with a "?". If the answer is correct, the computer places a "1" in the next row. If not, the incorrect answer disappears, the "?" returns, and the student must try again. There are five levels of difficulty. The computer keeps track of the number of incorrect answers and a percent score.

APPROXIMATE COST: $14.95

TITLE: Computer Chess

SUBJECT: Mathematics GRADE LEVEL: 2-10
SYSTEM: Atari 400/800 (Cartridge) (Joystick Controlled)

DESCRIPTION: Chess is played against the computer. Eight computer skill levels are available. In the easiest level, the computer only "thinks" about its next move for about 15 seconds. In the most difficult level, the computer can take up to 10 hours for a single move. Computer chess follows the basic moves of standard chess, including "castleing" and "en passant". It is also possible to promote the pawn by advancing it to the opposite side of the board.

APPROXIMATE COST: $39.95

TITLE: Apple Array

SUBJECT: Mathematics -- Multiplication GRADE LEVEL: 3-6
SYSTEM: Apple II Plus 32K 3.3 DOS (Disk)

DESCRIPTION: This is an extension of "Apple Barrel" except that apples fall into the barrel in uniform rows so that multiplication becomes the logical function.

The program can be used by the student with little or no teacher guidance.

APPROXIMATE COST: Public Domain

TITLE: Factor

SUBJECT: Math GRADE LEVEL: 4-7
SYSTEM: TRS-80 16K (Cassette)

DESCRIPTION: The program is designed for students to practice factoring and identifying primes in game format. Ordinal numbers are presented, starting with 1 and ending with number chosen by student. Student and program take turns. On the student's turn, s/he is asked to pick a number, trying to get the largest one whose factors remain on a predetermined list. The number selected is added to the student's score. Then, the taxman in the program gets the factors of the student's numbers that remain.

APPROXIMATE COST: $7.95

TITLE: Metric Roadrunner

SUBJECT: Math GRADE LEVEL: 4-7
SYSTEM: TRS-80 Model I 16K (Cassette)

DESCRIPTION: This program is in a game format and is used to practice estimating distances in centimeters. Coyote and Roadrunner shapes are placed on the screen in random locations. The student tries to make the Coyote "catch" the Roadrunner by estimating and typing in the distance between the two shapes -- so many centimeters up or down and/or right and left. If the student misses the distance, the program relocates both shapes and the student tries again. If student answers correctly, the program gives a vibrating message and chance to try again.

APPROXIMATE COST: $7.95

TITLE: Sets

SUBJECT: Mathematics GRADE LEVEL: 4-7
SYSTEM: Commodore/PET 8K (Cassette)

DESCRIPTION: Program allows practice in finding the union and intersection of two sets. The program presents two sets consisting of letters and asks for their union and intersection. If students answers correctly, the program so indicates and goes on to the next question. If the student is incorrect, the right answer is given, and the next problem is presented. An optional review lesson is available to introduce or review the set concept. The programs reports student performance after 10 problems.

APPROXIMATE COST: $19.95

TITLE: Sets and Numbers

SUBJECT: Math GRADE LEVEL: 4-7
SYSTEM: TRS-80 Model I (Level II BASIC) 16K (Cassette)

DESCRIPTION: Students acquire practice with sets and number sentences. The program presents a scored pre-test followed by optional practice on sets and number sentences. The program presents a problem, then accepts a number referring to the answer. If answer is correct, program continues. If incorrect, the program states the problem again; it allows unlimited trials. There is no performance report except on the pre-test.

APPROXIMATE COST: $24.95

TITLE: Compu-math Fractions

SUBJECT: Math GRADE LEVEL: 4-8
SYSTEM: Apple (Applesoft) 32K (Disk)

DESCRIPTION: Seven programs involving a pre-test and tutorials in fractions, definitions, common and lowest denominators, adding and subtracting, multiplication and division. The pre-test is multiple choice with items from all parts of the unit; it ends with a report and recommendation for placement of student within a unit.

APPROXIMATE COST: $39.95

TITLE: MECC--Elementary Vol. 3, Version 4.5

SUBJECT: Math, Social Studies GRADE LEVEL: 4-8
SYSTEM: Apple II Plus 48K 3.2DOS (Disk)

DESCRIPTION: Civil is a simulation of fourteen Civil War battles. Students decide how to allocate funds and other resources and what battle strategies to use. States and States 2 are drill programs for learning states and capitals.

Four Sell programs combine math concepts and business simulations. Programs demonstrate the influence of advertizing, finding the optimum price for a product and marketing techniques.

APPROXIMATE COST: $29.95

TITLE: Place Value

SUBJECT: Math GRADE LEVEL: 4-8
SYSTEM: Commodore/PET 8K (Cassette)

DESCRIPTION: Program is a tutorial on place value in decimal numbers. The program operates as follows: (1) introduces the decimal system and the values of digits in the one's through 1000's places; gives practice in determining the quantity of one's, ten's, etc., making up a number; introduces the relationship between regular and expanded numbers, e.g., 25 = (2X10) + (5X1), and gives practice with this concept; and gives practice (30 items) determining the value of numerals in each place, eg., what is the value of 5 in 8537? A performance report is given at end.

APPROXIMATE COST: $24.95

TITLE: Stalker

SUBJECT: Math, Basic Functions GRADE LEVEL: 4-8
SYSTEM: Apple II Plus 32K 3.3 DOS (Disk)

DESCRIPTION: This is a competitive math game for two players. Game paddles are required. Students select function, degree of difficulty (rank of officers) and size parameters for the numbers in each problem. The number of points to win (1-100) is also selected. Thus the teacher can control the length of the game to some degree. Four problems are shown simultaneously and these can be multiple function problems.

APPROXIMATE COST: Public Domain

TITLE: X Zone

SUBJECT: Math -- Coordinates, Logic GRADE LEVEL: 4-8
SYSTEM: Apple II Plus 32K 3.3 DOS (Disk)

DESCRIPTION: Student tries to find the intersections of two hidden lines on a grid. The computer gives color clues after each guess so that the student can made a logical next guess. Requires color monitor.

APPROXIMATE COST: Public Domain

TITLE: MECC Math. Volume I

SUBJECT: Mathematics GRADE LEVEL: 5-12
SYSTEM: Apple II 32K 3.2 DOS or 3.3 DOS

DESCRIPTION: Diskette contains 8 programs. Algebra presents simple algebraic equations with good drill and practice. Low level algebra only. Slope focuses on graphing a linear equation. Bagels, Snark and Radar are suitable for younger students who enjoy math and logic. Polar and Polygraph teach functions involving polar coordinates. ICBM teaches the coordinate system.
Good documentation is provided.

APPROXIMATE COST: $29.95

TITLE: Poker

SUBJECT: Mathematics GRADE LEVEL: 5-12
SYSTEM: Commodore/PET (Cassette) 16K minimum

DESCRIPTION: Designed to pit the skills of the player against the Computer House. Graphic displays depict: player's bet, draw cards, and bet again. The House is programmed to make moves in accordance with the hand it has been dealt and the nature of the betting which has taken place. The computer evaluates each hand, rearranges the cards appropriately, and displays a summary of each game. Total standings of the House and player are recorded and displayed after each game.

APPROXIMATE COST: $15

TITLE: Archimedes' Apprentice

SUBJECT: Mathematics GRADE LEVEL: 6-8
SYSTEM: TRS-80 Model I/III 16K (Cassette)

DESCRIPTION: The goal of the Archimedes' Apprentice is to teach the user the formulas for determining the volume of various geometric figures. The two programs cover parallelepipeds, prisms, pyramids, cylinders, cones and spheres.

APPROXIMATE COST: $9.95

TITLE: Algebra Billiards

SUBJECT: Mathematics GRADE LEVEL: 7-9
SYSTEM: TRS-80 Model I 16K (Cassette)

DESCRIPTION: The program gives practice in working algebra substitution problems at the same time a game of billards is going on. The program "racks up" the characters to be used in the upcoming problem, and the student "breaks" by pressing the "C" key (cueball). The characters bounce around and settle into the expression to be evaluated. The values of 2 variables are given. The student is asked to identify the unknown variable and then to direct a series of steps to solve the problem, using unknown values. Student starts with 15 points and loses some at each incorrect response.

APPROXIMATE COST: $16.95

TITLE: Geometry and Measurement Drill & Practice

SUBJECT: Mathematics GRADE LEVEL: 7-12
SYSTEM: Apple II Applesoft 32K DOS (Disk)

DESCRIPTION: This program has practice problems on lengths, areas, perimeters, angles, and volumes of various plane and solid figures. It is intended for students at the basic geometric level.

It uses high-resolution graphics to emphasize key points and provides short explanations for students having difficulty.

APPROXIMATE COST: $50

TITLE: Gross Pay

SUBJECT: Mathematics GRADE LEVEL: 7-12
SYSTEM: Commodore/PET (Disk)

DESCRIPTION: This program provides a number of word problems on "pay" for which the user must compute hourly, monthly, regular and over-time payments. Responses are given when the user supplies incorrect responses

APPROXIMATE COST: Public Domain

TITLE: Euclid Geometry Tutor

SUBJECT: Mathematics GRADE LEVEL: 10-12
SYSTEM: TRS-80 Model I/III 16K (Cassette)

DESCRIPTION: Program is designed to reinforce basic geometry concepts introduced by the teacher. Students develop proofs using 9 basic postulates of Euclidean Geometry. The program has 1 of 3 difficulty levels. In the second, the student enters statements, and the computer gives the reasons justifying the statement. In the third mode, the student provides both statements and reasons.

APPROXIMATE COST: $39.95

TITLE: Proofs and Properties

SUBJECT: Mathematics (geometry) GRADE LEVEL: 10-12
SYSTEM: Apple II Applesoft 3.2 or 3.3 DOS 32K (Disk)

DESCRIPTION: This program practices concepts used in doing geometric proofs. Proofs and properties presents a series of questions and problems on first semester geometry with emphasis on proofs and proving and the critical relational properties. It is designed to be run without external documentation. The disk is protected against copying and modification.

APPROXIMATE COST: $29.95

TITLE: Introductory Calculus

SUBJECT: Mathematics GRADE LEVEL: 11-12
SYSTEM: Apple II Plus or Commodore (Disk)

DESCRIPTION: The following programs are designed to support an introductory calculus course: Differentiation Algebraic Functions, Maxima/Minima Problems Part I, Maxima/Minima Problems Part II, Relative Problems Part I, Relative Rates Problems Part II, Integration of Algebraic Functions, Differentiation of Trigonometric Functions, Integration of Trigonometric Functions, Integration: Areas of Plane Figures, Integration: Volumes of Solids, Integration: Arc Lengths, and Integration: Surface Areas of Solids.

APPROXIMATE COST: $180 package

TITLE: Reading Programs

SUBJECT: Reading GRADE LEVEL: 3-6
SYSTEM: Commodore/PET (Disk)

DESCRIPTION: A series designed to master basic word attack patterns for dependable sound/symbol correspondence. 1,000 words taught in the series. "Of", "to" and "the" do not have a regular correspondence. Begins with a sentence on the screen for the student to type. Correct responses are reproduced and reinforced. The learner pronounces each word and is monitored. The screen clears after sentence is typed for the first time, then reappears with a word missing. Sentence is typed again and reappears with another part missing. Eventually, the learner types the entire sentence from memory. Performance is summarized.

APPROXIMATE COST: Complete set of 4 Type to Read Programs $511.75

TITLE: Critical Reading, Microsystem 80

SUBJECT: Reading/Logic GRADE LEVEL: 4-8
SYSTEM: Apple II 48K 3.3 DOS (Printer for management only)

DESCRIPTION: This is a supplemental reading program with special assistance for students who are low in comprehension. In simple to fairly complex paragraphs the user must eliminate the "or" statement or the "and" statement. Ultimately, the student is introduced to several rules of inference.

Good instructions and documentation.

APPROXIMATE COST: $750 (lease option)

TITLE: Comprehension Power Program

SUBJECT: Reading GRADE LEVEL: 4-12
SYSTEM: Apple II Plus 48K DOS 3.3

DESCRIPTION: 108 reading selections. Each level consists of 12 lessons on 4 diskettes. Step 1: Vocabulary Introduction: The student reviews the key words in context sentences. Step 2: The student displays segment of a reading selection in a preview allowing time to read, comprehend, and assimilate before displaying the next segment. At the end of the preview, 2 questions are presented and the student is given immediate feedback on both. Step 3: The student sets a reading rate and reads the selection as it is displayed. Each segment is followed by 1-3 comprehensive questions. Comprehension skills include: literal understanding, interpretation, analysis, evaluation, and appreciation.

APPROXIMATE COST: $150

TITLE: Preschool Fun

SUBJECT: Reading GRADE LEVEL: Preschl.-1
SYSTEM: Atari 400/800 8K (Cassette)

DESCRIPTION: Preschool Fun is a 2-program cassette designed to help teach the preschooler colors, numbers, shapes, letters (both capital and small), and directions (left, right, up, down). Along with all that, the package can also be used to introduce computers to young children.

The ideas in the package are presented in a similar format for the non-reading child. The format first prompts the child with the correct answer, then asks the child to determine the answer on his/her own.

APPROXIMATE COST: $15

TITLE: Letters and Numbers

SUBJECT: Reading GRADE LEVEL: K-1
SYSTEM: Commodore/PET 8K (Cassette)

DESCRIPTION: The program drills students on number and letter recognition. Letters and numbers presents exercises for upper and lower-case letters and numbers. The user may choose among exercises to drill via matching, sequence completion, and filling in the character. Upper-case letters can be matched with lower-case letters, and vice versa. Characters are displayed in large sizes.

APPROXIMATE COST: $20

TITLE: Speed Reading & Comprehension

SUBJECT: Reading GRADE LEVEL: 2-12
SYSTEM: Commodore/PET 16K (Cassette or Disk)

DESCRIPTION: The student reads text passages which are followed by comprehension tests. A rapid scan of a text passage is presented, followed by a line-by-line presentation of the same text for reading. Lastly, a multiple-choice quiz is given to measure the student's comprehension. The speed of text presentation may be increased or decreased by the reader while reading is going on and without stopping the program. The reader's speed and comprehension level is reported after the end of each session.

APPROXIMATE COST: 6 program cassette $49.94 disk $59.95

TITLE: Pool

SUBJECT: Science GRADE LEVEL: 6-9
SYSTEM: TRS-80 (Disk)

DESCRIPTION: The display screen shows a 1-pocket pool table. The user notes the location of the ball on the table and makes guesses about the angel the ball must bounce off the rail to proceed into the pocket. Cues are presented to help the student know where the ball will strike. Helps to demonstrate the principle of refraction. Score is maintained by the computer.

APPROXIMATE COST: Public Domain

TITLE: Polut

SUBJECT: Science/Ecology GRADE LEVEL: 6-10
SYSTEM: Commodore/PET 32K (Disk)

DESCRIPTION: Program allows students to investigate a body of water undergoing pollution. Several different types of water bodies, from a small pond to a fast moving stream, may be studied. Students are to vary several factors and to see effects on pollution and dissolved oxygen levels in the water; the factors include temperature, type of pollutant, and type of treatment the pollutant receives before entering the water. Effects are reported in a table, a graph, or both.

Documentation (available separately) includes a teacher's guide, a student workbook, and a resource handbook.

APPROXIMATE COST: $50

TITLE: Tari Trek

SUBJECT: Science GRADE LEVEL: 6-12
SYSTEM: Atari 24K (Cassette) and 32K (Diskette)

DESCRIPTION: Get ready for an exciting trek through space. Your mission is to rid the galaxy of Klingon warships, and to accomplish this you must use strategy to guide the starship Enterprise around stars, through space storms, etc. At the higher levels, users play against elapsed time.

APPROXIMATE COST: Cassette $11.95 Diskette $14.95

TITLE: Human Heart

SUBJECT: Science GRADE LEVEL: 8-12
SYSTEM: TRS-80 (Disk)

DESCRIPTION: A graphic representation of the human heart is placed on the display screen with numbers marking the various parts of the heart. The user is given the name of a part of the heart and responds by indicating the corresponding number. Program is written to give the user an unlimited opportunity to select the correct response.

APPROXIMATE COST: Public Domain

TITLE: Crypto

SUBJECT: Science GRADE LEVEL: 9-12
SYSTEM: Commodore/PET 8K minimum (Cassette)

DESCRIPTION: Designed to create cryptograms from various lines of text which are entered by the students. Either a second player or the computer will decipher the message when a code number is entered.

APPROXIMATE COST: $15

TITLE: Density

SUBJECT: Science GRADE LEVEL: 9-12
SYSTEM: Commodore/PET (Disk)

DESCRIPTION: The user is offered a number of opportunities for drill and practice in computing density and volume. The student enters both values and then checks his/her answers against the computer generated answer. A note pad for personal computations is required.

APPROXIMATE COST: Public Domain

TITLE: Weatherman

SUBJECT: Science GRADE LEVEL: 9-12
SYSTEM: Commodore/PET (Disk)

DESCRIPTION: There are 4 computation programs contained in this package:
1) Temperature Conversion, e.g. Celsius, Fahrenheit, Kelvin and Rankine.
2) Temperature/Humidity Index
3) Wind Chill Equivalent Temperatures.
4) Relative Humidity and Dew Point.
Separate computation note pad is necessary.

APPROXIMATE COST: Public Domain

TITLE: Energy and the Inclined Plane

SUBJECT: Science (Physics) GRADE LEVEL: 10-12
SYSTEM: Commodore/PET (Disk)

DESCRIPTION: Generates a series of 10 questions dealing with the analysis of the motion of a particle on an inclined plane. The concepts of work, kinetic energy and potential are thus reviewed.

APPROXIMATE COST: $20

TITLE: Kinematics

SUBJECT: Science (Physics) GRADE LEVEL: 10-12
SYSTEM: Commodore/PET 8K (Cassette)

DESCRIPTION: This program gives practice in computating questions regarding velocity, average acceleration, and distance traveled. The student answers questions from a graph or from their own computations. If the answer is incorrect the first time, the program either tells the student to check the graph or gives the student the relevant formula. On a second error, it displays the formula, computations, and final answer, then goes on to the next question.

APPROXIMATE COST: $20

TITLE: Physics Program II

SUBJECT: Science (Physics) GRADE LEVEL: 10-12
SYSTEM: Apple II Plus or Commodore (Disk)

DESCRIPTION: This series of programs includes practice and problems on such topics as: Specific Gas Laws, General Gas Law, Thermodynamics I, Thermodynamics II, Transverse Standing Waves, Longitudinal Standing Waves, Mirrors and Lenses, Refraction of Light, Series Circuit Analysis, Parallel Circuit Analysis I, Parallel Circuit Analysis II, Series/Parallel Analysis, Electric Field Analysis, Photoelectric Effect, Projectile Analysis.

APPROXIMATE COST: $180

TITLE: Pulley-System Machines

SUBJECT: Science (Physics) GRADE LEVEL: 10-12
SYSTEM: Commodore/PET (Disk)

DESCRIPTION: Generates a series of 7 questions dealing with the analysis of a pulley system consisting of a single, double, or triple fixed and moveable blocks. The concepts of work and efficiency are thus reviewed.

APPROXIMATE COST: $20

TITLE: Stoichiometry: General

SUBJECT: Science (Chemistry) GRADE LEVEL: 10-12
SYSTEM: Commodore/PET (Disk)

DESCRIPTION: Generates a series of questions dealing with stoichiometric relationships in chemical reactions. Mass/mass, mass/volume, and volume/volume problem types are randomly generated.

APPROXIMATE COST: $20

TITLE: Picture Kingdom

SUBJECT: Social Studies GRADE LEVEL: 4-9
SYSTEM: Commodore/PET (Disk)

DESCRIPTION: This simulation game is played by having the user act as a ruler, e.g., king or queen. By manipulating food production--with a changing population--in light of rats, disorders, attacks by Huns, etc., the ruler has to make well-calculated decisions.

APPROXIMATE COST: Public Domain

TITLE: States & Capitals

SUBJECT: Social Studies GRADE LEVEL: 4-10
SYSTEM: Atari 400/800 (Cassette)

DESCRIPTION: States and Capitals is a learning game to test and improve knowledge of both the states and their capitals and their geographic location. A map of the United States is drawn and a state is outlined. The object is to first name the state and then its capital, spelling both correctly. The number of correctly identified states and capitals are shown throughout the game.

APPROXIMATE COST: $14.95

TITLE: States

SUBJECT: Social Studies GRADE LEVEL: 4-11
SYSTEM: TRS-80 (Disk)

DESCRIPTION: This program is designed to show the geographic location on a map of the United States. The location of the state capital is Students are asked to name the capital and the state. The student can elect to try his/her skill by giving the correct responses in alphabetical or random order.

APPROXIMATE COST: Public Domain

TITLE: Edu-Disks (Readers Digest)

SUBJECT: Social Studies - Problem Solving GRADE LEVEL: 5-8
SYSTEM: Apple II Plus, Atari, TRS-80

DESCRIPTION: Teaches techniques in logical thinking and decision-making at grade levels 5-8. Highly interactive, it allows the learner to move comfortably from the concrete to the abstract. Problem-solving enhances a mathematics and science curriculum and, because problem-solving is so intimately associated with the interpretation of words, can well serve to enrich an English or reading curriculum.

APPROXIMATE COST: $174.96 - Level 5-6
$174.96 - Level 7-8

TITLE: Africa & Asia

SUBJECT: Social Studies GRADE LEVEL: 5-9
SYSTEM: Commodore/PET (Disk)

DESCRIPTION: This program offers the user a matching exercise to connect capitals with countries in Africa and Asia. The user is given two opportunities to answer with the correct response. The program will not advance until the user has given the correct response and provided the correct spelling of the capital.

APPROXIMATE COST: Public Domain

TITLE: State Guess

SUBJECT: Social Studies GRADE LEVEL: 5-10
SYSTEM: TRS-80 Model I/III 16K (Cassette)

DESCRIPTION: In this program, the student is to first choose a state and then answer questions which are posed in the program. If the student identifies the correct answer, the session is over. If not, the program asks for the state's name and the computer will either identify the problem as a spelling error (says it never heard of that state) or as an incorrect answer to one of the questions asked previously by the program; this ends the run.

APPROXIMATE COST: $24.95

TITLE: Water

SUBJECT: Social Studies GRADE LEVEL: 8-10
SYSTEM: Commodore/PET 32K (Disk)

DESCRIPTION: The basic concept of this program is for the student to acquire some skills in the area of managing water resources in a small town. The student manages many factors in a town threatened by imminent drought in order to try to save the town. Student has control over such factors as flow of water, availability of food, industrial goods, current population and budget. The program runs in simulated "real time" and the student must make decisions "on the fly."

APPROXIMATE COST: $50.00

TITLE: Energy Czar

SUBJECT: Social Studies GRADE LEVEL: 8-12
SYSTEM: Atari 400/800 16K (Cassette)

DESCRIPTION: In this simulation, the player (the Czar) has the power to control energy forms. The Czar can enact legislation to promote or restrict various energy supplies. The Czar controls the nation's economy. The Czar begins his reign in 1980 and enacts legislation for a five year period. Included is an instruction manual.

APPROXIMATE COST: $14.95

TITLE: Hail To The Chief

SUBJECT: Social Studies GRADE LEVEL: 8-12
SYSTEM: TRS-80 48K DOS (Disk)

DESCRIPTION: In this program, the student tries to be elected President of the U.S. S/he decides on a particular strategy and executes it, week by week. Student must make various decisions including what position to take on a variety of issues such as energy policy, what to do about unemployment, women's rights, health, mid-east policy and SALT. Candidates must manage financial aspects of their campaign including fund raising and expenditures. Total package includes four models of varying complexity. Each model comes in ten different levels of difficulty. Problems of campaign finance are introduced at the upper levels.

APPROXIMATE COST: $24.95

TITLE: Wall Street Challenge

SUBJECT: Social Studies GRADE LEVEL: 8-12

SYSTEM: Atari 400/800 8K and 16K (Cassette)

DESCRIPTION: Wall street challenge is a computer simulation game of the stock exchange. The player has the opportunity to buy and sell 8 different stocks. The player starts with $50,000 and must decide how much of which stock he wishes to purchase. A chart of the recent activity of each stock is available for study, as well as a chart of the recent overall action of the Dow-Jones average. Fortunes can be made and lost as the Dow Jones average and the individual stock's values rise and roll.

APPROXIMATE COST: $14.95

TITLE: MECC, Social Studies, Vol 2

SUBJECT: Social Studies GRADE LEVEL: 9-12

SYSTEM: Apple II Plus 32K, 3/3 DOS (Disk)

DESCRIPTION: Diskette contains eight programs. Bargain introduces user to the collective bargaining process. Continent gives practice in naming countries and continents. Country, States and States 2 are similar programs. Crisis and Fail Safe are dramatic simulations that provide decision-making opportunities in an highly stressful situation. Minnag may best be used as an example of an information retrieval system using a micro-computer

APPROXIMATE COST: $29.95

TITLE: New World Explorers

SUBJECT: Social Studies GRADE LEVEL: 9-12

SYSTEM: TRS-80 (Level II BASIC) 32K (Disk)

DESCRIPTION: New World Explorers is a simulation of an early explorer's voyage to a new world. Class is divided into teams which work cooperatively, making daily navigation decisions and mapping out the world as it is discovered.

It is up to each team to discover and map out a new world and to return home safely. Each team takes charge of a boat and must make decisions according to daily navigation and exploration based on information provided by the computer. Students use accompanying booklets. Students learn various simulation experiences and skills such as mapping, compass angles, latitude and longitude and record-keeping.

APPROXIMATE COST: $150.00

TITLE: Compu-Spell

SUBJECT: Spelling GRADE LEVEL: 4-8
SYSTEM: Apple II Plus 48K DOS 3.3 (Disk)

DESCRIPTION: A positive reinforcement system designed for classroom usage Compu-Spell features many of the most frequently misspelled words in the English language. (Each contains about 800-1200 spelling words displayed in sentences.)

APPROXIMATE COST: $29.95

TITLE: Spell Endings

SUBJECT: Spelling GRADE LEVEL: 4-9
SYSTEM: Commodore/PET (Disk)

DESCRIPTION: The student is given a number of words picked at random by the computer and then the user is to apply the correct ending, e.g., ing, ed, or plurals. The program will repeat those endings that are incorrect. Correct and incorrect totals are summarized at the conclusion of the program.

APPROXIMATE COST: Public Domain

TITLE: Spelling Rules

SUBJECT: Spelling GRADE LEVEL: 5-8
SYSTEM: Apple II (Applesoft) 32K 3.2 or 3.3 DOS (Disk)

DESCRIPTION: Introduces six common rules for use in spelling English words and provides practice and mastery testing in their use. The rules cover: the use of ie and ei; when to use a final e; adding k; final consonants; suffixes cede, ceed, and sede; when to use a final y.

APPROXIMATE COST: $29.95

TITLE: Word Families

SUBJECT: Spelling/Reading GRADE LEVEL: Pri-Sp. Ed.
SYSTEM: Apple II Plus 32K 3.2DOS

DESCRIPTION: This is a small program with limited usefulness. Essentially the computer asks the user to substitute one letter which would make a new word from the original word shown on the screen. Student needs some knowledge of basic sight words.

APPROXIMATE COST: $29.95

TITLE: Spell 'N Time

SUBJECT: Spelling GRADE LEVEL: 1-12
SYSTEM: Apple 16K (Applesoft) (Cassette)

DESCRIPTION: This program is a timed spelling drill on teacher-selected words. The word blinks inside a box and the student spells the word by typing it in another box. Incorrect spelling causes the word to blink inside the box by syllables. If the word is still misspelled, it remains in the first box as the student types it in the second box.

APPROXIMATE COST: $12.95

TITLE: Word Challenger

SUBJECT: Spelling GRADE LEVEL: 3-7
SYSTEM: TRS-80 Model I/III 16K (Cassette)

DESCRIPTION: This is a Hangman-like game in which one or two players try to guess a hidden phrase, one letter at a time. The phrases are supplied by the computer in one-player games or by the opponent if two are playing. The program keeps score as the game progresses, deducting 2 points for each incorrect consonant and 10 points for vowels not in the phrase. The program uses sound and graphics extensively.

APPROXIMATE COST: $9.95

Even a cursory glance at the descriptions illustrates the inadequacy of documentation. More information about software is necessary before a major investment is made. Reproduced here are two evaluation instruments--one from the Rock Springs School District in Wyoming and the other from the Northwest Regional Educational Laboratory in Portland, Oregon--that offer significant additional evaluation criteria.

The Computing Teacher

SOFTWARE EVALUATION FORM & CHECKLIST
(Permission to reprint is granted)

DATE _____ EVALUATOR _____
PROGRAM NAME _____ WRITTEN FOR _____ COMPUTER
VENDOR AUTHOR _____ IN _____ LANGUAGE
ADDRESS _____
CITY ST ZIP _____
PHONE _____
COST $ _____

PROGRAM CLASS (Check one or more boxes)
- ☐ Computer assisted instruction
- ☐ Computer managed instruction
- ☐ Administrative
- ☐ (Other) _____

SYSTEM REQUIRED (Check one or more boxes)
- ☐ 16K ☐ 32K ☐ 48K COMPUTER
- ☐ DISK DRIVE
- ☐ TAPE
- ☐ PRINTER ☐ W/GRAPHICS
- ☐ PLOTTER

INTENDED USER (Check one or more boxes)
- ☐ Teachers
- ☐ Students _____ Grade Level
- ☐ Other _____

PROGRAM MODE** (Check one or more boxes)
- ☐ Drill & Practice*
- ☐ Instructional Game*
- ☐ Instructional Management*
- ☐ Instructional Support*
- ☐ Program Solving or Research*
- ☐ Simulation*
- ☐ Test Construction or Analysis*
- ☐ Tutorial Instruction*
- ☐ Programming Utility
- ☐ Information
- ☐ Other (please specify) _____

GENERAL DESCRIPTION OR PURPOSE OF PROGRAM

The Computing Teacher

OVERVIEW OF PROGRAM CHARACTERISTICS

	LITTLE	SOME	MUCH
A. DOCUMENTATION AVAILABLE	☐	☐	☐
B. INSTRUCTION ORIENTATION NEEDED	☐	☐	☐
C. USER ORIENTATION NEEDED	☐	☐	☐
1. Directions (Verbal)	☐	☐	☐
2. Directions (Written)	☐	☐	☐
3. Systems Errors Handled	☐	☐	☐
4. Keyboard Input by User	☐	☐	☐
5. Dependence on Background or Prior Knowledge	☐	☐	☐

D. USER TARGET(S)
- ☐ Individual
- ☐ Group

E. INTERACTION
- ☐ Cooperation
- ☐ Competition

CHARACTERISTICS OF TEACHING STRATEGY/MOTIVATION
- ☐ Games ☐ Audio ☐ Student Control
- ☐ Color ☐ Graphics ☐ Ancillary Materials & Worksheets

SOUNDNESS OF CONTENT IS –
- ☐ Mathematically and Computationally Correct
- ☐ Conceptually Correct and Contemporary
- ☐ Compatible with Other Instructional Material in Use
- ☐ Instructionally Significant

ALL OVER GENERAL RATING
☐ Poor ☐ Fair ☐ Good ☐ Excellent ☐ Superior

OTHER COMMENTS

FORM DESIGN BOB HILGENFELD, SCHOOL DISTRICT No. 1, ROCK SPRINGS, WYOMING

Sample Program

NORTHWEST REGIONAL EDUCATIONAL LABORATORY

Program Description

PRODUCER:

VERSION:

SUBJECT: MEDIUM OF TRANSFER:

REQUIRED HARDWARE:

REQUIRED SOFTWARE:

INSTRUCTIONAL TECHNIQUES:

DOCUMENTATION AVAILABLE:

INSTRUCTIONAL OBJECTIVES: POTENTIAL USERS:

INSTRUCTIONAL PREREQUISITES: MAJOR STRENGTHS:

CONTENT AND STRUCTURE: MAJOR WEAKNESSES:

Evaluation Summary

SA	Content accuracy	SA	Appropriate motivational level	A	Program comprehensiveness
SA	Educational value	D	Challenges student creativity		Adequate packaging
SA	Lacks cultural stereotyping	A	Feedback effectively employed	SA	Effective information displays
A	Objectives well-defined	A	Student controls presentation of format	A	Clarity of instructions
A	Accomplishes stated objectives			A	Teacher facility with program
SA	Clarity of content presentation	A	Appropriate integration with prior learning	A	Appropriate use of computer technology
SA	Appropriate difficulty level				
SA	Appropriate graphics/sound/color	A	Content can be generalized	SA	Program reliability

SA = Strongly Agree A = Agree D = Disagree SD = Strongly Disagree NA = Not Applicable

Evaluators indicate they would use or recommend use of this package with little or no change.

Northwest Regional Educational Laboratory
300 S.W. Sixth Avenue • Portland, Oregon 97204 • (503) 248-6800

Space limits including many complete evaluations, but reproduced here are two. These, (originally printed in the Micro SIFT News*), were prepared by evaluators who worked for the Northwest Lab.

Program Description

Circulation (Organs)

PRODUCER. Micro Power and Light Company VERSION: N/A GRADES: 5-12 SUBJECT: Science: Human Circulatory System MEDIUM OF TRANSFER: 5" Flex. Disk REQUIRED HARDWARE: Apple II Plus, 32K, single disk drive, color monitor REQUIRED SOFTWARE: Applesoft, Dos 3.2 INSTRUCTIONAL TECHNIQUES: Drill and Practice, Tutorial, Game DOCUMENTATION AVAILABLE: Suggested grade/ability level, instructional objectives, program operating instructions, teacher's information

INSTRUCTIONAL OBJECTIVES: To teach the functions of the organs of the circulatory system.

INSTRUCTIONAL PREREQUISITES: Teacher should go through the instructional cycle with the student prior to using. Requires a third grade reading ability and some instruction in health or science at grades 3 or 4.

CONTENT AND STRUCTURE: The program teaches the functions of the heart, blood, arteries, capillaries, veins, and lungs. The student has a choice of three instructional modes: tutorials with animated sequences, true-false quizzes, and car race games using true-false questions and a time limit. Tutorial sequences are short and provide opportunities for the user to review the animations which are used to illustrate specific concepts. Tutorials include quizzes on previous lessons.

POTENTIAL USES: The program could be used to review science or health related topics, or for free time enrichment. It may also be used effectively as a resource center activity where students rotate through stations or it could be the focus of a class exercise with teams competing for points.

MAJOR STRENGTHS: Computer responses are "friendly." Correct answer is given if student gives an incorrect answer. The program is designed for easy entry and exit. The student can bypass previously studied material. There is plenty of opportunity for review. User controls rate of learning. Content is segmented into small units.

MAJOR WEAKNESSES: Use of blue color to represent lungs and cells that have received oxygen deviates from the usual color scheme. The option for students to play a game without going first to an instructional mode is presented too early. Students tend to go directly to the game option, later finding they cannot be successful if they skipped the instruction section.

Evaluation Summary

A	Content accuracy	A	Appropriate motivational level	A	Program comprehensiveness
SA	Educational value	A	Challenges student creativity	A	Adequate packaging
SA	Lacks cultural stereotyping	SA	Feedback effectively employed	A	Effective information displays
A	Objectives well-defined	SA	Student controls presentation of format	SA	Clarity of instructions
A	Accomplishes stated objectives			SA	Teacher facility with program
A	Clarity of content presentation	A	Appropriate integration with prior learning	A	Appropriate use of computer technology
A	Appropriate difficulty level				
A	Appropriate graphics/sound/color	A	Content can be generalized	SA	Program reliability

SA = Strongly Agree A = Agree D = Disagree SD = Strongly Disagree NA = Not Applicable

Evaluators indicate they would use or recommend use of this package with little or no change.

* Northwest Regional Educational Laboratory, 300 S.W. Sixth Avenue, Portland, Oregon 97204 (503) 248-6000

It is instructive to note the differences between the description of the Math Sequences program and the evaluation of the same program.

Program Description

Math Sequences

PRODUCER: Milliken Publishing Company VERSION: Apple II, Revised (TRS-80 and PET available) GRADES: 1-8 SUBJECT: Math: All elementary topics MEDIUM OF TRANSFER: 5" Flex. Disk REQUIRED HARDWARE: Apple II or with Applesoft ROM 48K RAM, disk drive, monitor REQUIRED SOFTWARE: Applesoft, Dos 3.2 or 3.3 INSTRUCTIONAL TECHNIQUES: Drill and Practice DOCUMENTATION AVAILABLE: Suggested grade/ability level, sample progam output, program operating instructions, teacher's information, resource/reference information, relationship to standard textbooks, ditto masters for student record keeping

INSTRUCTIONAL OBJECTIVES: Standard elementary math.

INSTRUCTIONAL PREREQUISITES: Package assumes math concepts have been taught. Student begins program at existing skill level.

CONTENT AND STUCTURE: The package consists of 12 diskettes in a 3-ring binder, a teacher's guide, duplicating masters for student record forms, and an instruction card. An optional automated instructional management system is included. The system provides drill and practice in standard elementary math topics including number readiness, basic operations, laws of arithmetic, fractions, decimals, percent, equations, and measurement formulas.

POTENTIAL USES: The package is designed to augment math instruction in an elementary classroom, lab or resource room. It may be used effectively with individuals or small groups. In grades 1-6 the package is appropriate for remediation, enrichment or on-level instruction; in grades 7-8 it may be used for on-level or remediation; at grade 9, for remediation only. Students may use the package independently with minimal training.

MAJOR STRENGTHS: The system is easy for students and teachers to use. Formating and presentation of instructional material is appropriate for skill levels taught. Student progress is governed by mastery and automatically adjusted. Inclusion of an optional automated instructional management system is an asset for teachers.

MAJOR WEAKNESSES: Students may have difficulty starting a session because habitual use of return key between response to name, class, and level, results in return to the beginning of the program. Management system lacks instruction and examples for easy classroom implementation.

Evaluation Summary

SA	Content accuracy	SA	Appropriate motivational level	A	Program comprehensiveness
SA	Educational value	D	Challenges student creativity		Adequate packaging
SA	Lacks cultural stereotyping	A	Feedback effectively employed	SA	Effective information displays
A	Objectives well-defined	A	Student controls presentation of format	A	Clarity of instructions
A	Accomplishes stated objectives			A	Teacher facility with program
SA	Clarity of content presentation	A	Appropriate integration with prior learning	A	Appropriate use of computer technology
SA	Appropriate difficulty level				
SA	Appropriate graphics/sound/color	A	Content can be generalized	SA	Program reliability

SA = Strongly Agree A = Agree D = Disagree SD = Strongly Disagree NA = Not Applicable

People interested in software evaluations can make an application to the regional laboratory to receive a copy of their periodic newsletter, which contains complete analyses, or to contact either or both of the following:

The International Council on Computers in Education (ICCE), Department of Computing & Information Sciences, University of Oregon, Eugene, Oregon 97403

or

Management Operations Information Bank, 1800 North Kent Street, Arlington, Virginia 22209

One other resource commands special attention: The service offered by this organization is outstanding. Similar models are needed. Among other things the:

Micro-Computer Center
San Mateo County Office of Education
333 Main Street
Redwood City, California 94063
(415) 363-5472

is...a demonstration center where educators can have hands-on experience with several micro-computers and determine which one may be best suited to their needs,

...an evaluation center where instructional software may be previewed for field-testing and evaluation before purchase,

...a software exchange where public domain micro-computer programs written by other educators may be copied for classroom use,

...an information center where books, journals, curriculum guides, computer literacy units and audio-visual materials related to the use of computers in instruction are readily available,

...a workshop center where educators can meet to share their experiences and where new products and programs can be presented.

At the San Mateo Center, programs donated to SOFTSWAP (public domain software) can be copied onto disks or tapes. SOFTSWAP programs can also be ordered by mail, either as a direct purchase or in exchange for an original contribution to the exchange.

So much for software!

SOME QUESTIONS TO PONDER

Interviews with administrators and teachers in school districts that have adopted micro-computers for curricular purposes offer valuable insights to questions that should be addressed by potential users. Any list reproduced here would, obviously, be incomplete, but, in spite of this restriction, here are some sample questions. They can serve as a spring-board for further brainstorming and dialogue.

- Is there anyone within the district who has a strong interest in micro-computer applications?
- Do we know any sales representatives who are aware of computer capabilities and student needs?
- Are there reputable micro-computer companies in our area? Is their maintenance and service reliable?
- Should we write our own, or should we purchase already written software?
- Should we invest in the training of computer programmers?
- How can we integrate software programs into our course of study?
- Do we want the computer system to supplement teachers or do we want the teachers to supplement the system?
- What kind of staff development is necessary?
- Should applications other than CAI be considered?
- For initial purchase, what level of sophistication should the system represent?
- How much attention should be given to the issue of system compatibility?
- Do we have any person (or team of people) qualified to evaluate software programs?
- Where can we obtain money to purchase either the machinery or the software?
- Will we need additional personnel to assist with the micro-computers?
- Where might volunteer parents be identified to assist in a computer-laboratory?
- Who will train the volunteers?
- Should we design a laboratory or should we place a micro-computer in each classroom?
- What public relations program is necessary?
- What strategies are useful for helping teachers and administrators accept micro-computers as integral to all parts of the school curricula?
- How can the effectiveness of applications be evaluated?

In education, more than any other field, perhaps, there are two techniques to keep anything from happening.

1) Establish a committee to study it, (whatever "it" may be), and
2) Study it to death.

These barriers were not in mind when the preceding questions were presented. If district decision-makers waited to inaugurate micro-computer applications until every question were answered satisfactorily, most people pondering the issues very likely would move on to the great micro-computer sanctuary in the sky. The "final" data on any question may never be available. Questions should be used in a way that district representatives can think before jumping; the questions and their answers can also be used to make "in-flight corrections" as necessary. District leaders serious about micro-computers should develop a series of questions unique to their district.

GLOSSARY

Micro-computer people have developed a language of their own--as have lawyers, pilots, carpenters, auto mechanics, educators and others. Lay people are sometimes intimidated by educators who use code-words to communicate. Educational code-words include: words, catchy phrases, abbreviations, e.g., basic competencies, diagnostic-prescriptive teaching, P.L. 94-142. Computer people have their favorites as well, and their vocabulary can also be intimidating. The list of "in-the-know" terms below is a primer list for the beginner. When one masters the words and phrases, he or she can then practice quickie sentences to drop nonchalantly into inane cocktail conversation. Don't be shy about using the terms, a lot of people do even though they may not be certain about precise definitions.

BASIC--This is one of the most widely used computer languages, especially for most inexpensive computers. The letters stand for "Beginners All-purpose Symbolic Instruction Code." BASIC is now required by some schools as part of the computer literacy course.

BYTE--One character. The storage capacity of a computer is generally expressed in bytes, e.g., 4K, 8K, 16K, etc. Since K=1,024, a 4K storage capacity equals 4,096 bytes.

BINARY CODE--Numbers and other quantities inside a computer are coded using a binary system. This system uses just two digits, 0 or 1.

CENTRAL PROCESSING UNIT--This is the hardware unit in the computer system that takes instructions from computer memory, clarifies what the instructions specify, and carries out the instructions. The CPU is generally quick to process routine instructions--an oft-stated advantage of computers.

CHIP--In the early days of computers, vacuum tubes and transistors formed part of the circuitry which made the computer work. Later on, a small silicon "chip" was designed to replace the tubes and transistors. As more and more research is conducted, smaller and smaller chips are being designed to handle greater and greater loads, especially as the central processing unit of a micro-computer. The San Jose, California area is sometimes called "Silicon Valley" because many companies that research and develop computer-chips are located there.

COMPUTER--An electronic digital machine designed for the input, storage, processing and output of symbols, usually alphabetic or numerical. A computer can very rapidly execute pre-detailed, step-by-step directions stored in its memory. A computer system consists both of hardware and software, e.g., machinery or equipment and programs, respectively.

COMPUTER ASSISTED INSTRUCTION (CAI)--One function of the computer is to assist students in instruction. The assistance may take a variety of forms--drill and practice, programmed learning sequences with limited or multiple operations depending on the success (or lack of success) of the user, and sophisticated interactive systems designed to teach high-level, problem-solving. Obviously, the effectiveness of CAI is no greater than the software programs that define the instructional approach.

COMPUTER LITERACY--Knowledge about the computer, what it will and won't do. For discussion purposes, computer literacy is often divided into two levels, e.g., the awareness level and the functional or working level. Many people

believe the awareness level is quite adequate for most educators. Computer literacy may become a required course of study for high school students in the near future; the course is already an elective in many schools.

COMPUTER MANAGED INSTRUCTION (CMI)--As well as providing computer assisted instruction, a computer can also perform some of the organizational and management aspects of instruction including record-keeping, diagnostic testing and prescriber functions. Management of instruction is especially powerful because of:

- speed of calculation and retrieval of information
- accuracy and realiability in carrying out operations
- capacity to maintain a large number of detailed records in an organized fashion
- capacity to do repetitive tasks endlessly.

CONVERSATIONAL INTERACTION--As the user puts data into the computer, the computer provides feedback. This back-and-forth operation is called "interaction." When programs are well-written and when the user attends diligently to the feedback, the transactions become nearly as smooth as a two-person conversation. The user can interact with the computer almost as he/she can talk with another person.

DISK--There are two levels of storage, primary and secondary. A form of secondary storage, designed to store large quantities of data, is a disk. A disk is a soft, plastic, record-like device. Usually the disk is flexible and is, therefore, often referred to as a "floppy disk." For most micro-computer applications a floppy disk measuring 5¼ inches (resembling a 45RPM record) is used. Some micro-computer disks are also made of metal. Hard disks generally have greater storage capacity and are, as a result, somewhat more expensive. Floppy disks, also sometimes called "diskettes," are priced in the $3 to $6 range.

DISK DRIVE--A disk drive houses--provides storage for--disks. Most disk drives are designed so expansion units can be added, resulting in additional storage capacity. At least one type of micro-computer can be outfitted to accomodate up to 33 million hard disk characters.

HARDWARE--The physical components that make-up a micro-computer system are called hardware. The main hardware components are input units, storage units, processing units and output units. For an inexpensive micro-computer system, the input and output units can be combined into a typewriter-style keyboard terminal; secondary storage may be accomplished with an inexpensive cassette tape-recorder.

INTERACTION--Many micro-computers are built so a person can interact with them while a problem is being solved. Interaction is often performed with a type-writer-like unit although on some systems a user can interact with a light-pencil or even with one's finger. If current research is successful, a user will be able to interact with just his/her voice. The Japanese are currently leading this area of research.

K--The term used to describe the capacity for computer storage. The primary storage of a computer is often stated as a number of K bytes of storage, e.g., 16K, 32K, etc.

MEMORY--All micro-computers have storage space; the storage space is the memory unit. Various people claim the memory space is similar to the human mind. Other people believe the memory portion of a computer system is similar to a magnetic tape that can be recorded, played and erased. In either case, memory is used to remember information fed it, performs prescribed instructions and retains intermediate answers. Primary storage is normally contained inside the computer while secondary storage is normally contained outside the computer--frequently on a floppy disk.

MENU-DRIVER--Software is often written in such a way that users have a number of options from which to choose. The options are sometimes displayed as a table of contents or as a "menu." The menu arrangement allows the user to select a particular offering separate from other topics on the menu.

MICRO-COMPUTER--A type of computer; its central processing unit consists of one or a few large scale integrated circuits (chips). Currently there are four major brands of micro-computers used reasonably extensively in schools. Although there are other brands of micro-computers--and more will soon find their way to the market place--Atari, Apple, TRS-80 and PET lead the parade. The engineers who designed these systems managed to develop compact, relatively inexpensive machines that can out-perform many of the earlier, costlier and larger computer models. Micro-computers cost in the $300 to $5,000 price range depending on storage desired, accessory components and the desired level of sophistication. Generally, computers with larger storage can perform the same operations as computers with less storage--and other unique applications as well.

MODELING (Simulation)--Science, math, business and a number of other disciplines often use complex formulas, equations, and so forth. When a computer is used to solve equations and carry out other necessary calculations, the process is called a computer simulation (model). Modeling and simulation are essential tools when real-life applications are impossible or impractical.

MODULAR--Most programs are broken up into smaller pieces called modules. A number of modules fitted together form an entire program. Even within a specific menu choice, the program may contain a number of modular units.

NETWORKED TERMINALS--Sometimes keyboards and other types of hardware in separate locations are all tied to a central processing unit. Common information can be shared at the various terminals. Airline reservations are often placed through a networked terminal. This larger system is usually faster and it has more storage than stand-along micro-computers.

PROGRAM--A sequence of instructions which cause the computer to carry out desired actions. Simple programs are relatively easy to write. Many elementary students, for instance, enjoy the challenge and success of writing simple programs. For complex computer applications, though, the task of programming is reserved for specialists. The job is exceptionally time-consuming. Rather than investing many, many hours learning to make the computer work, most educators find their time used more efficiently when they describe to a specialist (programmer) whatever is desired. The person with the appropriate talents should do the programming.

PROGRAM LANGUAGE--Every computer is constructed in such a way that it uses one or more programs written in "machine language." There are four or five fundamental machine languages; among the most popular are BASIC, COBOL, LOGO, PASCAL and FORTRAN. A specific language is often considered as particularly appropriate for specific groups of users. COBOL, for instance, is especially applicable for those in the world of business; BASIC is the student-oriented language most often favored. For any program to be used on a specific type of micro-computer, a translating program is required. Atari, Apple, etc. each require a different translating program.

PROMPT--A prompt is a message displayed by the computer to help users make correct responses to computer requests for information. The prompt is one way the computer performs its work consistent with the pace established by the user.

SOFTWARE--Software is a general term which refers to any kind of computer program. Software is used in conjunction with the machinery that comprises the computer system. Many schools are now building a library of software programs. Software programs are designed both by commercial and non-commercial (public domain) developers. Educators building a software library are cautioned to evaluate programs carefully before adding them as instructional aids. Software is written at varying levels of difficulty. One way to evaluate any program is to have teachers and students interact with the program via hands-on experiences.

WORD PROCESSING--The computer functions as an automated typewriter--and more. Paragraphs of standard manuscript copy, in rough or complete form, are stored in memory. Following editing procedures, final copy is printed rapidly by a unit interfaced with the computer. The valuable and efficient editing capabilities and rapid-printing give the word processing operation of a micro-computer many advantages.

Clearly, the preceding terms are limited as far as a complete repretoire is concerned. These little tidbits, though, can serve as a foundation for further development. Once an elementary vocabulary is gained, a quick trip to the local library will surely yield a few of the new periodicals that describe micro-computers. Nearly any article is good for a few new phrases of jargon. If the library doesn't have appropriate periodicals, here are a few sources that might be helpful:

Classroom Computer News
P.O. Box 266
Cambridge Massachusetts

The Computing Teacher
University of Oregon
Eugene, Oregon 97403

School Microwave
Dresden Associates
P. O. Box 246
Dresden, Maine 04342

Micro-Computer Directory: Application in Educational Settings
Harvard School of Education
Cambridge, Massachusetts 02138.

IN RETROSPECT

Computer Assisted Instruction (CAI) makes use of a computer to present instruction to students. At its simplest level, CAI software is merely rote drill and practice, the system functioning as a benevolent (usually) drill master. There are certainly cheaper alternatives to the drill and practice mode. Moderately sophisticated software is similar to a programmed learning, a text which helps students progress at their own pace. At the most sophisticated level are a few dialogue systems wherein the computer and student interact in higher-level problem-solving activities. Hopefully, greater attention will be aimed at this level.

In spite of what is (and there really isn't a lot at this embryonic stage of growth), there is always the potential of, "What might be?" Indeed, micro-computer systems present an exciting challenge for many educators.

Although the potential for micro-computers is great, there were also amazingly positive pronouncements regarding instructional television during its early days. ITV still isn't especially powerful after nearly 25 years of pioneering. It may never be. Will we have similar conclusions for the micro-computer potential as we have had for the ITV potential? What will be the status in the year 2005 A.D.?

With anything new, various constraints and barriers stand in the way of progress. This publication has listed some common concerns and has suggested several alternative courses of action, especially for the novice.

Optimistically, every problem is resolvable. In the final analysis success is usually dependent on both inspiration and prespiration--"If we think we can, or if we think we can't, we'll be right either way."

RESOURCES - SELECTED BIBLIOGRAPHY

"So You Want to Buy A Computer?" Instructor, Volume 89, No. 8, March, 1980.

"Potential and Limits of Computers in Schools." Educational Leadership, Volume 37, No. 6, March, 1980.

"How To Make the Right Decisions About Micro-Computers." Instructional Innovator, September, 1980.

"Match Your New Computer To Your Needs." On Computing, Volume 3, Summer 1981.